REQUIRED RANGE OF KNOWLEDGE - Water Treatment Plant Operator, Grade 1

Applicants are not expected to have a complete mastery of all subjects but at least should have heard of them in the context of water quality and treatment. Ability in basic arithmetic and an understanding of basic conversions is requisite. Introduction to regulatory concepts.

SECTION	TOPIC	REFERENCE
Regulatory Knowledge	Safe Drinking Water Act; Compliance and Enforcement; Operator Certification Program; R18-4-101 and R18-5-101 Define: CWS, NTNCWS, MCL, Compliance Cycle, Compliance Period, Facility, Backflow and Cross Connection, Small, Medium and Large Water System; On –Site Operator	Arizona Administrative Code, Title 18, Chapter 4, Articles 1 definitions and Title 18, Chapter 5, Article 1,definitions; R18-4-303(B); R18-5-104-(C) (E); R18-5-108(A); R18-5-109.C
Sources of Supply	Hydrologic cycle; Chemical, physical, and bacteriological characteristics,; Groundwater and surface water supplies; Sanitary hazards for each type of water supply	CSUS Water Treatment Plant Operator, Vol. 1, 4th Ed., CH 2, 3; R18-4-301(.E),R18-4-302(A); AWWA, Principles and Practices of Water Supply Operation, 3rd Ed., Water Sources
Disinfection	Purpose of disinfection; Disinfectant types; Characteristics of chlorine and chlorine compounds; Available chlorine in various compounds; Chlorine demand, Free vs. Combined chlorine; Breakpoint chlorination; meaning, significance, determination; Residual measurement; Gas vs. Liquid; application and methods; Effects of pH and temperature; chloramines; Relative effects on bacteria, viruses, cysts Define: Hypochlorous acid, Hydrochloric acid, Hypochlorite ion, Elmental chlorine, chlorine dioxide, Monochloramine, Dichloramine, and Trichloramine,	CSUS Water Treatment Plant Operator, Vol. 1, 4th Ed., CH 7; Handbook of Chlorination and Alternative Disinfectants, 4th Ed. Or other Chlorination and Disinfection reference material.

SECTION	TOPIC	REFERENCE
Elementary Chemistry	Elements; Compounds; pH; Acids and bases; Chemical reactions; chemical symbol for calcium, fluorine, copper; Molecular Structure of chlorine, Molecular weight of a compound	General Chemistry Textbook
Water Quality Parameters	Source water and finished water description; Microbiological; Organic; Inorganic; Radiological; Mineral; Physical; Hardness; Alkalinity; Significance of changes in pH and alkalinity; Watershed management; Oxygen starvation (methemoglobinemia) in infants;	CSUS Water Treatment Plant Operator, Vol. 1, 4th Ed., CH 2,3,7,9,11,14; Vol. 2, 3th Ed., CH 14,
Microbiological and Chemical Quality	Bacteria, viruses, and protozoan; Coliform group; occurrence, significance; Oxygen starvation (methemoglobinemia) in infants; Potential waterborne diseases; Sampling requirements	CSUS Water Treatment Plant Operator, Vol. 1, 4th Ed., CH 7, 11 CSUS Water Treatment Plant Operator, Vol. 2, 3rd Ed., CH 21
System Operation & Maintenance	Sanitary hazards; Cross-connection control, Pump types ,reciprocating, calculation of pump output; Instrumentation; Diagnosis of minor electrical problems; Cathodic protection; Electric motors and controls; Check valves; Lubricants use and storage	R18-4-101, CSUS Water Treatment Plant Operator, Vol. 2, 4th Ed.CH 18,20
Coagulation, Flocculation, Sedimentation	Calculation of coagulant dosage rates; Common coagulants and coagulant aids; turbidity, alkalinity, Suspended matter and colloidal particles; Turbidity and color; Taste and odor control, PAC; ion exchange, Potassium Permanganate	CSUS Water Treatment Plant Operator, Vol. 1, 4th Ed.CH 3,9; ; AWWA, Principles and Practices of Water Supply Operation, Water Treatment, 3rd Ed.
Safety	Common hazards; Sanitary hazards; Equipment; Emergencies, Lock out/Tag out; Confined space entry; Confine space procedures	R18-4-101, CSUS Water Treatment Plant Operator, Vol. 2, 4th Ed. CH, 20; ADOSH Section 1910.146 Permit-required confined spaces

SECTION	TOPIC	REFERENCE
Chlorine gas safety	Detection of leaks; Hazards and safety requirements for all types of disinfectants; Characteristics of fusible plugs in chlorine containers; Effects of heat applied to chlorine cylinder;1-ton cylinder components Protection against inhalation of chlorine gas; Feed rate as effected by temperature, cylinder volume, and cylinder position; Chlorine storage, feeding, and measurements; Operation and maintenance of an auto analyzer, hypochlorinator and gas chlorinator; Effects of moisture on chlorine gas	CSUS Water Treatment Plant Operator, Vol. 1, 4th Ed. CH 7; Handbook of Chlorination and Alternative Disinfectants, 4th Ed. Or other Chlorination and Disinfection reference material.
Introduction to Security concerns	Detection, Delay and Response, Emergency Response Plan; System map types and use ,engineering drawings, stationing, plan and profile; R18-4-116	Reference: Water and Wastewater Security Product Guide, “Visual Surveillance Monitoring,” USEPA, April 20, 2004 ~ Protecting Your Community's Assets: A Guide for Small Wastewater Systems, NETCSC, Nov. 2002, page 38 ~ Emergency Planning Interactive Guide, Illinois Section American Water Works Association and Midwest Technology Assistance Center, www.isawwa.org (click on "Emergency Planning CD"), Mutual Aid Overview page. ~ Emergency Preparedness U.S.A., FEMA, Unit 1, pages 1-2 ~ Guarding Against Terrorist and Security Threats: Suggested Measures for Drinking Water and Wastewater Utilities, Appendix B of Emergency Response Plan Guidance for Small and Medium Community Water Systems to Comply with the Public Health Security and Bioterrorism Preparedness and Response Act of 2002, USEPA, April 7, 2004

SECTION	TOPIC	REFERENCE
Introduction to Mathematics	Formulas; Units and conversion factors; Water measurements; Concentrations; Volume; Area; Flow rates and chemical feed rates; Percentage; Fractions; filtration rates	CSUS Water Treatment Plant Operator, Vol. 1,2 4th Ed.

REQUIRED RANGE OF KNOWLEDGE - Water Treatment Plant Operator, Grade 2

Applicants are expected to be familiar with all subjects listed under Grade 1. They are not expected to have complete mastery of all subjects but at least should have some familiarity of them in the context of water quality and treatment. The ability to make common water works measurements, calculations, and conversion is expected. Enhanced knowledge of regulatory concepts.

SECTION	TOPIC	REFERENCE
Regulatory Knowledge	Safe Drinking Water Act; Source Water Protection Program; Wellhead Protection Program; Compliance and Enforcement; Capacity Development; Operator Certification Program; R18-4-101 and R18-5-101 Define: Compliance Cycle, Compliance Period, POE, Facility, Backflow and Cross Connection Control, Small, Medium and Large Water System; VOC,	Arizona Administrative Code, Title 18, Chapter 4, Articles 1 definitions and Title 18, Chapter 5, Article 1,definitions; R18-4-101; R18-4-104(N); R18-4-104(U)(1), (2)(B); R18-4-116 (A); R18-4-206 (E)(1),(K)(3) ; R18-4-208(H); R18-4-209(I); R18-4-212 (A),(K) (1) (2); R18-4-219(A); R18-4-216(M) (1)(2); R18-4-503(A); R18-4-601(A); R18-4-118 (D); R18-4-115(A)(2); R18-5-116(C)
Sources of Supply	Hydrologic cycle; Chemical, physical, and bacteriological characteristics, Iron and Manganese in Groundwater and surface water supplies; Sanitary hazards for each type of water supply; Watershed management and Non-Point Source Pollution	CSUS Water Treatment Plant Operator, Vol. 1, 4th Ed., CH 2, 3; Vol. 2, 4th Ed., CH 12; AWWA, Principles and Practices of Water Supply Operation, Water Sources, 3rd Ed. R18-4-301(.E),R18-4-302(A)
Microbiological and Chemical Quality	Bacteria, viruses, and protozoan; Coliform group; occurrence, significance; Oxygen starvation (methemoglobinemia) in infants; Potential waterborne diseases; Sampling requirements	CSUS Water Treatment Plant Operator, Vol. 1, 4th Ed., CH 7, 11 CSUS Water Treatment Plant Operator, Vol. 2, 3rd Ed., CH 21; ; AWWA, Principles and Practices of Water Supply Operation, Water Quality, 3rd Ed.;
Elementary Chemistry	Elements; Compounds; pH; Acids and bases; Chemical reactions; chemical symbol for Arsenic, , Lead and copper; Molecular Formula of Calcium Hypochlorite, Chlorine Dioxide, Hydrofluoric Acid, Sodium Hydroxide and Hypochlorite, Sulfuric Acid, Ammonium Ion Molecular weight of a compound; Standardization of a solution; Polyphosphates; Langelier index; Health concerns of Fluoride	General Chemistry Textbook; AWWA, Principles and Practices of Water Supply Operation, Water Quality, 3rd Ed. CSUS Water Treatment Plant Operator, Vol. 1, 4th Ed., CH 11, Vol. 2, 4th Ed.CH 12

SECTION	TOPIC	REFERENCE
Water Quality Parameters	Source water and finished water description; Microbiological; Organic; Inorganic; Radiological; Mineral; Physical; Hardness; Alkalinity; Significance of changes in pH and alkalinity; Watershed management; Oxygen starvation (methemoglobinemia) in infants;	CSUS Water Treatment Plant Operator, Vol. 1, 4th Ed., CH 2,3,7,9,11,14; Vol. 2, 3th Ed., CH 14,
Disinfection	Purpose of disinfection; Disinfectant types; Characteristics of chlorine and chlorine compounds; Available chlorine in various compounds; Chlorine demand, Free vs. Combined chlorine; Breakpoint chlorination; meaning, significance, determination; Residual measurement; Gas vs. Liquid; application and methods; Effects of pH and temperature; chloramines; Relative effects on bacteria, viruses, cysts; Disinfection Byproducts Precursors, TTHM formation and HAA5 Define: Hypochlorous acid, Hydrochloric acid, Hypochlorite ion, Elmental chlorine, chlorine dioxide,Monochloramine, Dichloramine, and Trichloramine,	CSUS Water Treatment Plant Operator, Vol. 1, 4th Ed., CH 7; ; AWWA, Principles and Practices of Water Supply Operation, Water Treatment, 3rd Ed.; Handbook of Chlorination and Alternative Disinfectants, 4th Ed. Or other Chlorination and Disinfection reference material.
System Operation & Maintenance	Sanitary hazards; Pump types ,reciprocating, calculation of pump output; Instrumentation; Diagnosis of minor electrical problems, overload relays; Cathodic protection and corrosion control; Electric motors and controls, couplings; Check valves, Gate and Globe valves, eccentric valves; Lubricants use and Storage; Filtration, Mixed Media, Gravity; Cascade and Spry Aerator Systems; Prechlorination	R18-4-101, CSUS Water Treatment Plant Operator, Vol. Vol. 1, 4th Ed. CH Vol. 2, 4th Ed.CH 18,20; AWWA, Principles and Practices of Water Supply Operation, Water Treatment 3rd Ed.

SECTION	TOPIC	REFERENCE
Chlorine gas safety	Detection of leaks; Hazards and safety requirements for all types of disinfectants; Characteristics of fusible plugs in chlorine containers; Effects of heat applied to chlorine cylinder; 1-ton cylinder components Protection against inhalation of chlorine gas; Feed rate as effected by temperature, cylinder volume, and cylinder position; Chlorine storage, feeding, and measurements; Operation and maintenance of an auto analyzer, hypochlorinator and gas chlorinator; Effects of moisture on chlorine gas;	CSUS Water Treatment Plant Operator, Vol. 1, 4th Ed.CH 6 and 7; Handbook of Chlorination and Alternative Disinfectants, 4th Ed. Or other Chlorination and Disinfection reference material. Formulas; Units and conversion factors; Water measurements; Concentrations; Volume; Area; Flow rate and Detention Times; Chemical feed rates; Percentage; Fractions; Filtration rates
Introduction to Security concerns	Detection, Delay and Response, Emergency Response Plan; System map types and use ,engineering drawings, stationing, plan and profile; R18-4-116	Reference: Water and Wastewater Security Product Guide, “Visual Surveillance Monitoring,” USEPA, April 20, 2004 ~ Protecting Your Community's Assets: A Guide for Small Wastewater Systems, NETCSC, Nov. 2002, page 38 ~ Emergency Planning Interactive Guide, Illinois Section American Water Works Association and Midwest Technology Assistance Center, www.isawwa.org (click on "Emergency Planning CD"), Mutual Aid Overview page. ~ Emergency Preparedness U.S.A., FEMA, Unit 1, pages 1-2 ~ Guarding Against Terrorist and Security Threats: Suggested Measures for Drinking Water and Wastewater Utilities, Appendix B of Emergency Response Plan Guidance for Small and Medium Community Water Systems to Comply with the Public Health Security and Bioterrorism Preparedness and Response Act of 2002, USEPA, April 7, 2004

SECTION	TOPIC	REFERENCE
Coagulation, Flocculation, Sedimentation	Calculation of coagulant dosage rates; Detention Time; Common coagulants and coagulant aids; turbidity; Ph and alkalinity, Suspended matter and colloidal particles; Turbidity and color; Taste and odor control, PAC; ion exchange, Potassium Permanganate	CSUS Water Treatment Plant Operator, Vol. 1, 4th Ed.CH 3,9
Math Concepts	Formulas; Units and conversion factors; Water measurements; Concentrations; Volume; Area; Flow rate and Detention Times; Chemical feed rates; Percentage; Fractions; Filtration rates	CSUS Water Treatment Plant Operator, Vol. 1, 4th Ed.CH 3,9 CSUS Water Treatment Plant Operator, Vol. 1,2 4th Ed.; General Math Textbook

REQUIRED RANGE OF KNOWLEDGE - Water Treatment Plant Operator, Grade 3

Applicants are expected to have mastered all items listed under Grades 1 and 2, and a familiarity with the subjects listed under Grade 3. Must have the ability to make a wide range of water treatment calculations. Well-developed knowledge of national and local drinking water regulations.

SECTION	TOPIC	REFERENCE
Regulatory Knowledge	Safe Drinking Water Act; Source Water Protection Program; Wellhead Protection Program; Compliance and Enforcement; Capacity Development; Operator Certification Program; R18-4-101 and R18-5-101 Define: Compliance Cycle, Compliance Period, POE, Facility, Backflow, Cross-connection control, VOC	Arizona Administrative Code, Title 18, Chapter 4, Articles 1 definitions and Title 18, Chapter 5, Article 1,definitions; R18-4-101; R18-4-104(N); R18-4-104(U)(1), (2)(B); R18-4-106(A); R18-4-116 (A); R18-4-118(B) R18-4-206 (E)(1)(2),(K)(3), (L) R18-4-208(E)(H); R18-4-209(I); R18 4-212 (A),(K) (1) (2); R18-4-216(M) (1)(2); R18-4-219(A); R18-4-304 (A)(1)(2)(3) R18-4-308 (A); R18-4-314(A) R18-4-503(A); R18-4-601(A); R18-4-118 (D); R18-4-115(A)(2); R18-5-115(A)(1) R18-5-116(C)
Sources of Supply	Hydrologic cycle; Chemical, physical, and bacteriological characteristics, Iron and Manganese in Groundwater and Surface Water Supplies and Causes of Water Quality Problems; Sanitary hazards for each type of water supply; Watershed management and Non-Point Source Pollution; Thermal Stratification,	CSUS Water Treatment Plant Operator, Vol. 1, 4th Ed., CH 2, 3 ; Vol. 2, 4th Ed., CH 12; AWWA, Principles and Practices of Water Supply Operation, Water Supply 3rd Ed.; R18-4-301(.E),R18-4-302(A)

SECTION	TOPIC	REFERENCE
System Operation & Maintenance	Sanitary hazards; Pump types ,reciprocating, , Double Suction; calculation of pump output; Instrumentation; Diagnosis of minor electrical problems, overload relays and Magnetic Starters; Flow Meters; Cathodic protection and corrosion control; Sodium Fluoride, Characteristic, safety and application, Electric motors and controls, couplings; Check valves, Gate and Globe valves, eccentric valves; Prechlorination; SCADA and GIS Systems; Surge Protection	R18-4-101, CSUS Water Treatment Plant Operator, Vol. Vol. 1, 4th Ed.CH 6,8; AWWA, Principles and Practices of Water Supply Operation, Water Treatment3rd Ed. Vol. 2, 4th Ed.CH 12, 13, 18, 19, 20
Filtration Operation & Maintenance	Filtration, Mixed Media, Gravity; Filter Media Sizing, Gravity; Sludge Handing and Land Application; Types of Sludge Centrifuges; Flux Membrane; Ion Exchange, Regeneration and Residual Waste Stream; Iron Fouling	CSUS Water Treatment Plant Operator, Vol. Vol. 1, 4th Ed.CH 5, 6, Vol. 2, 4th Ed., Ch. 17 AWWA, Principles and Practices of Water Supply Operation, Water Treatment 3rd Ed.
Microbiological and Chemical Quality	Bacteria, viruses, and protozoan; Coliform group; occurrence, significance; Oxygen starvation (methemoglobinemia) in infants; Potential waterborne diseases; Sampling requirements; Membrane filter test for Total Coilform	CSUS Water Treatment Plant Operator, Vol. 1, 4th Ed., CH 7, 11 CSUS Water Treatment Plant Operator, Vol. 2, 3rd Ed., CH 21; AWWA, Principles and Practices of Water Supply Operation, Water Quality 3rd Ed.

SECTION	TOPIC	REFERENCE
Elementary Chemistry	Elements; Compounds; pH; Acids and bases; Chemical reactions; chemical symbol for Arsenic, , Lead and copper; Molecular Formula of Calcium Hypochlorite, Chlorine Dioxide, Hydrofluoric Acid, Sodium Hydroxide and Hypochlorite, Sulfuric Acid, Ammonium Ion Molecular weight of a compound; Standardization of a solution; Polyphosphates; Langelier index; Health concerns of Fluoride; Molecular Formula for Calcium Hypochlorite, Chlorine Dioxide, Hydrofluoric Acid, Sodium Hydroxide, Sodium Hypochlorite, Sulfuric Acid, Ammonium Ion; Methemoglobinemia	General Chemistry Textbook; CSUS Water Treatment Plant Operator, Vol. 1, 4th Ed., CH 11, Vol. 2, 4th Ed., CH 12
Water Quality Parameters	Source water and finished water description; Microbiological; Organic; Inorganic; Radiological; Mineral; Physical; Hardness; Alkalinity; Significance of changes in pH and alkalinity; Watershed management	CSUS Water Treatment Plant Operator, Vol. 1, 4th Ed., CH 2,3,7,9,11,14; Vol. 2, 3th Ed., CH 14,

SECTION	TOPIC	REFERENCE
Disinfection	Purpose of disinfection; Disinfectant types; Characteristics of chlorine and chlorine compounds; Available chlorine in various compounds; Chlorine demand, Free vs. Combined chlorine; Breakpoint chlorination; meaning, significance, determination; Residual measurement; Gas vs. Liquid; application and methods; Effects of pH and temperature; chloramines; Relative effects on bacteria, viruses, cysts; Disinfection Byproducts Precursors, TTHM formation and HAA5; Phenol Reaction Define: Hypochlorous acid, Hydrochloric acid, Hypochlorite ion, Elmental chlorine, chlorine dioxide,Monochloramine, Dichloramine, and Trichloramine,	CSUS Water Treatment Plant Operator, Vol. 1, 4th Ed., CH 7 AWWA, Principles and Practices of Water Supply Operation, Water Treatment 3rd Ed. Handbook of Chlorination and Alternative Disinfectants, 4th Ed. Or other Chlorination and Disinfection reference material.
Coagulation, Flocculation, Sedimentation	Calculation of coagulant dosage rates; Detention Time; Common coagulants and coagulant aids; turbidity; Ph and alkalinity, Total and Phenolphthaiein Alkalinity; Suspended matter and colloidal particles; Turbidity and color; Taste and odor control, PAC; ion exchange, Alum and Quicklime interactions: Potassium Permanganate	CSUS Water Treatment Plant Operator, Vol. 1, 4th Ed.CH 3,9; AWWA, Principles and Practices of Water Supply Operation, Water Treatment 3rd Ed.
Water Softening	Calcium Hydroxide, Calcium Oxide, Sodium Carbonate, Sodium Chloride	CSUS Water Treatment Plant Operator, Vol. 2, 4th Ed., Ch. 14 AWWA, Principles and Practices of Water Supply Operation, Water Treatment 3rd Ed.

SECTION	TOPIC	REFERENCE
Introduction to Security concerns	Detection, Delay and Response, Emergency Response Plan; System map types and use ,engineering drawings, stationing, plan and profile; R18-4-116; AWWA, Emergency Planning for Water Utilities, M19 4th Ed. Ch. 1	Reference: Water and Wastewater Security Product Guide, "Visual Surveillance Monitoring," USEPA, April 20, 2004 ~ Protecting Your Community's Assets: A Guide for Small Wastewater Systems, NETCSC, Nov. 2002, page 38 ~ Emergency Planning Interactive Guide, Illinois Section American Water Works Association and Midwest Technology Assistance Center, www.isawwa.org (click on "Emergency Planning CD"), Mutual Aid Overview page. ~ Emergency Preparedness U.S.A., FEMA, Unit 1, pages 1-2 ~ Guarding Against Terrorist and Security Threats: Suggested Measures for Drinking Water and Wastewater Utilities, Appendix B of Emergency Response Plan Guidance for Small and Medium Community Water Systems to Comply with the Public Health Security and Bioterrorism Preparedness and Response Act of 2002, USEPA, April 7, 2004
Chlorine gas safety	Detection of leaks; Hazards and safety requirements for all types of disinfectants; Characteristics of fusible plugs in chlorine containers; Effects of heat applied to chlorine cylinder; 1-ton cylinder components Protection against inhalation of chlorine gas; Feed rate as effected by temperature, cylinder volume, and cylinder position; Chlorine storage, feeding, and measurements; Operation and maintenance of an auto analyzer, hypochlorinator and gas chlorinator; Effects of moisture on chlorine gas;	CSUS Water Treatment Plant Operator, Vol. 1, 4th Ed.CH 6 and 7; Handbook of Chlorination and Alternative Disinfectants, 4th Ed. Or other Chlorination and Disinfection reference material.

SECTION	TOPIC	REFERENCE
Math Concetps	Formulas; Units and conversion factors; Water measurements; Concentrations; Volume; Area; Flow rate and Detention Times; Chemical feed rates; Percentage; Fractions; Filtration rates; Unit Filter Run Volume; Weir Loading Rate; Specific Gravity	CSUS Water Treatment Plant Operator, Vol. 1,2 4th Ed; General Math Textbook

REQUIRED RANGE OF KNOWLEDGE - Water Treatment Plant Operator, Grade 4

Applicants are expected to have mastered all items listed under Grades 1, 2, and 3 plus a practical familiarity with treatment plant design, water utility management, safety, and public health. Must have the ability to make a wide range of water utility calculations. Extensive knowledge of all drinking water regulations.

SECTION	TOPIC	REFERENCE
Regulatory Knowledge	Safe Drinking Water Act; Source Water Protection Program; Wellhead Protection Program; Compliance and Enforcement; Capacity Development; Operator Certification Program; Lead and Copper; Tap Water Monitoring; Safe Drinking Water Act; Source Water Protection Program; Wellhead Protection Program; Compliance and Enforcement; Capacity Development; Operator Certification Program; R18-4-101 and R18-5-101 Define: Compliance Cycle, Compliance Period, POE, Facility, Backflow	Arizona Administrative Code, Title 18, Chapter 4, Articles 1 definitions and Title 18, Chapter 5, Article 1,definitions; R18-4-101; R18-4-104(N); R18-4-104(U)(1), (2)(B); R18-4-106(A); R18-4-116 (A); R18-4-118(B) R18-4-206 (E)(1)(2),(K)(3), (L) R18-4-208(E)(H); R18-4-209(I); R18 4-212 (A),(K) (1) (2); R18-4-216(M) (1)(2); R18-4-219(A); R18-4-304 (A)(1)(2)(3) R18-4-308 (A); R18-4-314(A) R18-4-503(A); R18-4-601(A); R18-4-118 (D); R18-4-115(A)(2); R18-5-115(A)(1) R18-5-116(C);R18-4-310
Sources of Supply	Hydrologic cycle; Chemical, physical, and bacteriological characteristics, Iron and Manganese in Groundwater and Surface Water Supplies and Causes of Water Quality Problems; Sanitary hazards for each type of water supply; Watershed management and Non-Point Source Pollution; Thermal Stratification,	CSUS Water Treatment Plant Operator, Vol. 1, 4th Ed., CH 2, 3 ; Vol. 2, 4th Ed., CH 12; AWWA, Principles and Practices of Water Supply Operation, Water Supply 3rd Ed.; R18-4-301(.E),R18-4-302(A)

SECTION	TOPIC	REFERENCE
Disinfection	Purpose of disinfection; Disinfectant types; Characteristics of chlorine and chlorine compounds; Available chlorine in various compounds; Chlorine demand, Free vs. Combined chlorine; Breakpoint chlorination; Residual measurement; Gas vs. Liquid; Effects of pH and temperature; chloramines; Hydrogen Chloride; Relative effects on bacteria, viruses, cysts; Disinfection Byproducts Precursors, TTHM formation and HAA5; Phenol Reaction Define: Hypochlorous acid, Hydrochloric acid, Hypochlorite ion, Elmental chlorine, chlorine dioxide, Monochloramine, Dichloramine, and Trichloramine,; Oxygen starvation (methemoglobinemia) in infants;	CSUS Water Treatment Plant Operator, Vol. 1, 4th Ed., CH 7; AWWA, Principles and Practices of Water Supply Operation, Water Treatment 3rd Ed. Handbook of Chlorination and Alternative Disinfectants, 4th Ed. Or other Chlorination and Disinfection reference material.
Elementary Chemistry	Elements; Compounds; pH; Acids and bases; Chemical reactions; chemical symbol for Arsenic, , Lead and copper; Molecular Formula of Calcium Hypochlorite, Chlorine Dioxide, Hydrofluoric Acid, Sodium Hydroxide and Hypochlorite, Sulfuric Acid, Ammonium Ion Molecular weight of a compound; Standardization of a solution; Polyphosphates; Langelier index; Health concerns of Fluoride; Molecular Formula for Calcium Hypochlorite, Chlorine Dioxide, Hydrofluoric Acid, Sodium Hydroxide, Sodium Hypochlorite, Sulfuric Acid, Ammonium Ion	General Chemistry Textbook; CSUS Water Treatment Plant Operator, Vol. 1, 4th Ed., CH 11, Vol. 2, 4th Ed., CH 12

SECTION	TOPIC	REFERENCE
Water Quality Parameters	Source water and finished water description; Microbiological; Organic; Inorganic; Radiological; Mineral; Physical; Hardness; Alkalinity; Significance of changes in pH and alkalinity; Watershed management	CSUS Water Treatment Plant Operator, Vol. 1, 4th Ed., CH 2,3,7,9,11,14; Vol. 2, 3th Ed., CH 14,
Coagulation, Flocculation, Sedimentation, Filtration	Calculation of coagulant dosage rates; Detention Time; Common coagulants and coagulant aids; turbidity; Ph and alkalinity, Total and Phenolphthaiein Alkalinity; Suspended matter and colloidal particles; Turbidity and color; Taste and odor control, PAC; ion exchange, Alum and Quicklime interactions: Potassium Permanganate; Upflow Saturator; Membrane Filtration;demineraillization	CSUS Water Treatment Plant Operator, Vol. 1, 4th Ed.CH 3,4,5,6,7,9, Vol. 2,4th Ed. Ch.12, 13,14,; AWWA, Principles and Practices of Water Supply Operation, Water Treatment 3rd Ed.
System Operation & Maintenance	Spectrophotometer Operation; Pump types; Instrumentation; ; Sludge Handing and Land Application; Flux Membrane; Ion Exchange, Regeneration; Iron Fouling	R18-4-101, CSUS Water Treatment Plant Operator, Vol. Vol. 1, 4th Ed.CH 6,8; Vol. 2, 4th Ed.CH 17,19; AWWA, Principles and Practices of Water Supply Operation, Water Treatment 3rd Ed.
Chlorine gas safety	Detection of leaks; Hazards and safety requirements for all types of disinfectants; Characteristics of fusible plugs in chlorine containers; Effects of heat applied to chlorine cylinder; 1-ton cylinder components Protection against inhalation of chlorine gas; Feed rate as effected by temperature, cylinder volume, and cylinder position; Chlorine storage, feeding, and measurements; Operation and maintenance of an auto analyzer, hypochlorinator and gas chlorinator; Effects of moisture on chlorine gas; Chlorine Gas IDLH	CSUS Water Treatment Plant Operator, Vol. 1, 4th Ed.CH 6 and 7; NIOSH Pocket Guide to Chemical Hazards; Handbook of Chlorination and Alternative Disinfectants, 4th Ed. Or other Chlorination and Disinfection reference material.

SECTION	TOPIC	REFERENCE
Introduction to Security concerns	Detection, Delay and Response, Emergency Response Plan; System map types and use ,engineering drawings, stationing, plan and profile; R18-4-116	Reference: Water and Wastewater Security Product Guide, "Visual Surveillance Monitoring," USEPA, April 20, 2004 ~ Protecting Your Community's Assets: A Guide for Small Wastewater Systems, NETCSC, Nov. 2002, page 38 ~ Emergency Planning Interactive Guide, Illinois Section American Water Works Association and Midwest Technology Assistance Center, www.isawwa.org (click on "Emergency Planning CD"), Mutual Aid Overview page. ~ Emergency Preparedness U.S.A., FEMA, Unit 1, pages 1-2 ~ Guarding Against Terrorist and Security Threats: Suggested Measures for Drinking Water and Wastewater Utilities, Appendix B of Emergency Response Plan Guidance for Small and Medium Community Water Systems to Comply with the Public Health Security and Bioterrorism Preparedness and Response Act of 2002, USEPA, April 7, 2004
Math Concepts	Formulas; Units and conversion factors; Water measurements; Concentrations; Volume; Area; Flow rate and Detention Times; Chemical feed rates; Percentage; Fractions; Filtration rates	CSUS Water Treatment Plant Operator, Vol. 1,2 4th Ed; General Math Textbook